



# Typing In Mid-Air With Mixed Reality

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## Introduction

The mixed reality HoloLens generation 2 headset has many capabilities that require the use of text entry using a virtual keyboard. This study is currently in the preliminary stages of data collection.

### Objectives

- Investigate strengths and weaknesses of using one-hand versus two-hand text input methods while typing on the HoloLens 2 virtual keyboard.
- Compare results to those of a past study conducted on the performance differences between controller and gesture text input methods using the HoloLens generation 1 headset (Derby, Rarick, & Chaparro 2019).

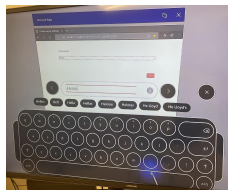


Figure 1. User view of typing on virtual keyboard

## Method

### Participants

- 3 college students, ages 20-24
- 1 of 3 reported previous experience with HoloLens



### Measures

- Typing Speed & Accuracy** – Words per Minute (WPM), Adjusted WPM (AdjWPM), and Word Error Rate (WER)
- Perceived Exertion** – Borg CR10 with a Body Map
- Perceived Workload** – NASA TLX-R
- Perceived Eye Strain** – Six 5 point Likert-scale questions
- Perceived Usability** – System Usability Scale (SUS)
- User Preference & Recommendations** – User comments and rating of input methods (0-50 scale)

### Procedure

- Participant receives study briefing and demographic questionnaire
- Participant fits and calibrates the headset
- Randomly assigned the one-hand or two-hand text input method
- Type 5 practice phrases and 15 test phrases from the MacKenzie phrase set (MacKenzie & Soukoreff, 2003)
- Questionnaires (SUS, Eye Fatigue, NASA\_TLX, BORG CR-10)
- Participants complete 3 & 4 with the other text input method
- Participants rate the methods and answer open-ended questions

## Procedure

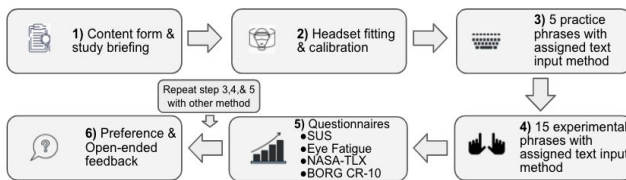


Figure 2. Procedure

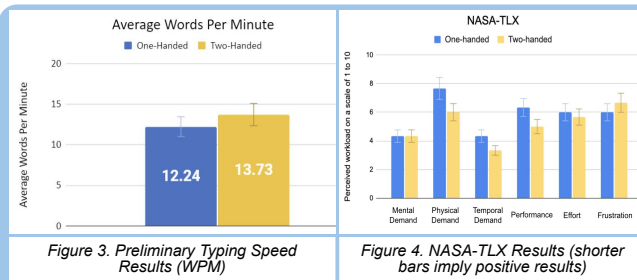


Figure 3. Preliminary Typing Speed Results (WPM)

Figure 4. NASA-TLX Results (shorter bars imply positive results)

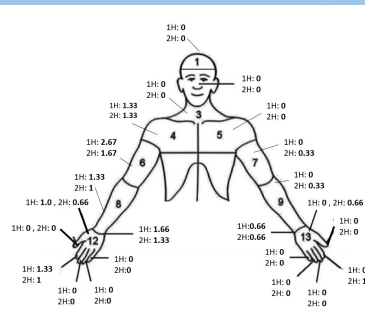


Figure 5. Borg CR-10 Scale Results

## Results

These results are not final, as we are still in the preliminary stage of data collection.

### Typing Speed & Accuracy

- The two-hand text input method is slightly faster ( $M = 13.73$  WPM,  $M = 13.64$  AdjWPM) than the one-hand method ( $M = 12.24$  WPM,  $M = 12.24$  AdjWPM)
- Word error rate was low for both methods (1%-2%) due to most participants fixing their phrases before submission

### Perceived Exertion

- The two-hand input method showed less exertion in the right bicep than the one-hand method

### Perceived Workload & Strain (NASA-TLX)

- The two-hand method so far has a lower perceived workload in physical demand, temporal demand, and performance

### Perceived Usability

- So far, one-handed ( $M = 65$ ) and two-handed text input ( $M = 66$ ) were given an "OK" perceived usability rating

### User Preference

- 2 of the 3 participants preferred the two-hand text input method

## Discussion

- Although we are in the preliminary stages of data collection, we have identified an increase in typing speed and performance ( $M = 12.98$  WPM) when compared to typing speed of the HoloLens generation 1 using gesture ( $M = 5.41$  WPM) (Derby, Rarick, & Chaparro, 2019).
- Thus far, participants have an "OK" perceived usability for both methods ( $M = 65.5$ ), whereas the HoloLens 1 had a "Poor" perceived usability ( $M = 45.29$ ).

## References

Derby J.L., Rarick C.T., Chaparro B.S. (2019). Text Input Performance with a Mixed Reality Head-Mounted Display (HMD). *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*;63(1), 1476-1480.

MacKenzie, I., S., & R., W., Soukoreff. (2003, April). Phrase Sets for Evaluating Text Entry Techniques. In *CHI'03 extended abstracts on Human factors in computing systems*, 754-755.